

The Association of Market Mix of Hospital Ownership With Medical Disputes: Evidence From China

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Tianjiao Lan^{1,2}  and Jay Pan^{1,2} 

Abstract

The prevalence and severity of medical disputes in China have attracted the attention of society and academia, and how to alleviate medical disputes has become a major concern. Following the implementation of a series of policies, the private sector in China's hospital market has expanded rapidly over the past decade. It remains unknown whether the market mix of hospital ownership could alleviate medical disputes, this study aims to bridge the gap. Data are collected from all hospitals (2171) in Sichuan province, China, from 2012 to 2015. Using a negative binomial hurdle model, the results show that for hospitals with disputes, the private hospital market share has an inverted U-shaped relationship with the number of disputes. However, no significant relationship is found between the private hospital market share and the probability of dispute occurrence. For hospitals with disputes, competition plays a protective role in the effect of the private hospital market share on the number of disputes, hindering the increase in the number of disputes and facilitating a more rapid drop. However, medical quality is found to play an insignificant role in that effect. The findings also support encouraging new private hospitals in China rather than privatizing existing public hospitals.

Keywords

medical dispute, market mix of hospital ownership, private hospital, competition, China, health reform

What do we already know about this topic?

How to control the increasing number of medical disputes is a critical challenge for the management of the healthcare delivery system in China. One main policy put forward to address this was encouraging the development of private hospitals to enhance delivery capacity and fuel competition in the healthcare market in the new round of China's health reform since 2009.

How does your research contribute to the field?

Our study provides empirical evidence for the context of China, which is one of the largest developing countries globally.

What are your research's implications toward theory, practice, or policy?

The findings support that increasing the private sector in the healthcare market would alleviate medical disputes through the competition mechanism.

Introduction

This study employs the geopolitical boundaries approach and the private hospital market share to respectively define the hospital market and measure the market mix of hospital ownership. Accordingly, this study applies a negative binomial hurdle model to all hospitals in Sichuan province, China, from 2012 to 2015, to explore the relationship between the market mix of hospital ownership and medical disputes.

Medical disputes in China have surged over the past decade, and their occurrence has remained high in recent years. According to a survey in Guangzhou, the largest city in south China, the annual growth rate of medical disputes in

¹West China School of Public Health and West China Fourth Hospital, Sichuan University, Chengdu, China

²Institute for Healthy Cities and West China Research Center for Rural Health Development, Sichuan University, Chengdu, China

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Corresponding Author:

Jay Pan, West China School of Public Health and West China Fourth Hospital, Sichuan University, No. 17, Section 3, Ren Min Nan Road, Chengdu, Sichuan, 610041, China.

Email: panjie.jay@scu.edu.cn



dentistry reached 19.6%, and their number doubled between 2008 and 2012.¹ The statistics from China's National Health Commission show that, in 2013 alone, there were about 70 000 medical disputes across the country.² Despite a 20.1% drop in the number of annual medical disputes from 2013 to 2018,³ China still has tens of thousands of medical disputes each year. The growing tense atmosphere between physicians and patients has led to verbal abuse, threats, and even violence.⁴⁻⁶ Although data from China's National Health Commission show that 9831 "major disturbances" involving physical violence in health institutions were reported in 2006, this figure almost doubled to 17 243 by 2010.^{7,8} On average, each hospital in China handles 27 cases of violence against physicians per year.⁹ The prevalence and severity of medical disputes in China have attracted the attention of both society and academia, and how to ease the physician-patient relationship to alleviate medical disputes has become a major concern.

Causes of medical disputes are diverse and numerous, and include patients' high economic burdens, less-than-expected quality of medical care, lack of physician-patient communication, and poor internal hospital management.^{1,7,10} However, patient dissatisfaction with the services provided by physicians and hospitals remains the root cause of most medical disputes. Therefore, an effective means of alleviating medical disputes is to prompt suppliers to provide more satisfactory services to patients, which calls for reform of the entire health services delivery system.

A new round of national health reforms was launched by the Chinese government in 2009.¹¹ One of the main policies is promoting the development of the private sector in the hospital market by relaxing the entry and business barriers for private hospitals.¹² Private hospitals are encouraged to provide not only more diversified (high-end) services but also basic medical services.¹³ As a beneficial addition to hospital market entities, the introduction of private hospitals would also intensify hospital competition,¹⁴⁻¹⁶ leading to an increase in the capacity and efficiency of the whole healthcare delivery system.

Following implementation of a series of policies, the private sector in China's healthcare delivery system has expanded rapidly over the past decade. According to the Health Statistical Yearbook of China, private hospitals have outnumbered public hospitals since 2015, accounting for 60.4% of all hospitals in 2017. Furthermore, the proportion of private hospital beds doubled from 10.5% in 2009 to 24.3% in 2017.^{17,18}

Considering the introduction of private hospitals followed by the change in the structure of the entire healthcare delivery system, this study is concerned about whether development of private hospitals could ease the physician-patient relationship and facilitate a decrease in the number of medical disputes. Related studies provide limited evidence on how the market mix of hospital ownership affects medical disputes. Pan et al¹⁹ utilized survey data to explore the determinants of patient dissatisfaction; they identify the market

share of private hospitals as one determinant and find that it has a negative association with patient satisfaction. Yang and Pan²⁰ did not directly study the market share of private hospitals, but analyzed the relationship between hospital competition and the probability of medical dispute occurrence, finding an inverted U-shaped relationship between them. Employing qualitative research called the root cause analysis, Yu et al²¹ found that the lack of hospital competition can give rise to an increase in medical disputes.

To supply additional evidence, this study utilizes the rich variation in private hospital market share, brought about by different levels of private hospital development across time and regions, to distinguish the effect of the market mix of hospital ownership on medical disputes, and provide important policy implications for ongoing discussions on the reform of the market mix of hospital ownership.

The remainder of this paper is organized as follows. Background briefly describes the hospital ownership, level, and reimbursement mechanism in China. The Data and methods section describes the hypothesis, data, variables, and analysis method. The Results section presents the empirical results and robustness tests. Discussion presents a discussion of the results, and Conclusion concludes the paper.

Background

In general, hospitals in China can be divided into public and private hospitals according to their ownership.²² All public hospitals are non-profit, while private hospitals consist of both non-profit and for-profit hospitals. Non-profit hospitals are tax-exempted and characterized by the "non-distribution constraint" which requires them to use their surplus revenue to further their mission (improve quality of care and population health) rather than to distribute the surplus to the organization's shareholders or individuals as profit.²³ Public hospitals are designed to provide basic medical services to people at affordable prices.²⁴ All public hospitals are contracted with social basic health insurance programs and subject to the government's price regulation. Unlike public hospitals, private hospitals, both for-profit and non-profit, can set their own prices. However, a critical prerequisite for private hospitals to apply to become contracted with social basic health insurance programs is that their service prices cannot be higher than the government-regulated prices (i.e., the same as public hospitals)—this means that private hospitals must accept the government's price regulation. Once a private hospital is contracted with social basic health insurance, the reimbursement policy of such insurance for patients seeking treatment in that hospital is the same as that in public hospitals.

China regulates hospitals based on different levels and grades. In practice, they are classified into three levels (primary, secondary, and tertiary) and three grades (A, B, and C) for each level.²⁵ Hospitals at different levels play different roles in the delivery system. The primary hospitals mainly

provide treatments for common diseases and rehabilitative services. Secondary hospitals are regional hospitals that receive referrals from primary hospitals. Tertiary hospitals are always medical centers in the region, providing treatments for patients with critical and severe conditions.²⁶

A key criterion for hospital classification is the hospital bed number. Primary hospitals have fewer than 100 beds, secondary 100 to 500, and tertiary more than 500. All hospitals, no matter what type of ownership, follow the same classification. In general, the higher the level of the hospital, the higher the ceiling of government-regulated prices (if the prices of hospital services are regulated by the government). In terms of the reimbursement policy of social basic health insurance, the reimbursement ratios of different level hospitals are diverse, and the ratios of higher-level hospitals are generally lower.

Data and Methods

Hypothesis

Based on the private sector's controversial role in the health-care delivery system, we hypothesize that the market mix of hospital ownership has a mixed effect on the number of medical disputes. Two possible mechanisms are proposed to summarize the effect's path.

The first is the competitive mechanism. The market mix of hospital ownership could decrease the number of medical disputes through hospital competition. New private hospitals would enrich patient choice and consequently intensify hospital competition.¹⁴⁻¹⁶ Private hospitals, most of which are profit maximizers,²⁷ might be more cost-conscious and more efficient than those in the public sector.²⁸ Growth in the number of private hospitals followed by more competitive pressure could lead hospitals, especially public hospitals, to focus on attracting more patients, giving rise to an increase in efficiency, decrease in costs, and improvement in services.^{29,30} Thus, hospitals could provide patients with higher quality, lower cost, and more satisfactory medical services, resulting in a decrease in the number of medical disputes.

On the other hand, the market mix of hospital ownership could increase the number of medical disputes via hospital competition. Unlike general markets, healthcare markets are characterized by information asymmetry.^{31,32} When facing fierce competition, hospitals might exploit this distinct feature to induce unnecessary services,³³ leading to an increase in medical costs. Moreover, when the degree of competition increases, private hospitals tend to competitively equip with advanced medical devices to signal higher medical quality and attract patients. In response, public hospitals would be forced to enter the medical arms race,³⁴ and a vicious circle would be created. The excessive devices would be costly, and the costs incurred would be transferred to patients, consequently escalating medical cost while providing only limited improvement in medical quality.³⁵ Moreover, private hospitals might even diminish medical quality for cost

control.³⁶ The growth in private hospitals would aggravate this problem, since increasing competition leads to an increase in survival pressure, eventually giving rise to further reductions in medical quality. Therefore, the expansion of private hospitals followed by greater hospital competition could result in more medical disputes.

The second is the regulation mechanism. The effect of the market mix of hospital ownership on the number of medical disputes would vary according to the level of government regulation. The health services delivery system in China has been dominated by public hospitals since the country's founding^{37,38}; thus, the Chinese government has inherently limited experience regulating private hospitals. Further, unlike public hospitals, the authorities are unable to participate in the internal regulation of private hospitals, which can make management decisions independently.³⁹ In this relatively looser regulatory environment, it is easier for private hospitals than public hospitals to evade supervision and hide existing problems.⁴⁰ Within a certain range, growth in the number of private hospitals would increase the prevalence of this phenomenon and exacerbate the market environment, leading to an increase in the number of medical disputes. However, when private hospital development reaches a certain level, the government would gradually strengthen its supervision and regulation of private hospitals, cleaning up the entire hospital market and decreasing the number of medical disputes.

Data

Our study area is the Sichuan province, a southwestern province in China (Figure 1a). The land area and GDP per capita of the province rank 5th and 21st among the 31 provinces of Mainland China, respectively, with a population of 83.02 million in 2017.^{18,41} We choose Sichuan as our research area mainly due to data accessibility. All the hospitals (2171) in the 183 counties in Sichuan province during 2012 to 2015 are included.

Figure 1b to d shows the great disparity in geography, demography, and economic development among the regions in Sichuan province. Eastern Sichuan features plains and dense population, while the features of western Sichuan are the opposite.³⁵ In terms of economic development, GDP per capita is higher in central areas where the provincial capital (Chengdu city) is located, and it is relatively lower in the eastern and western areas.

Since private hospital development could be strongly associated with geographic, demographic, and economic factors within areas, there would be wide variations in private hospital development among regions in Sichuan. This provides us with a unique opportunity to explore the relationship between private hospital market shares and medical disputes. Figure 2b shows the private hospital development in the province during the study period, as well as the regional variation in private hospital distribution in 2015 (Figure 2a).

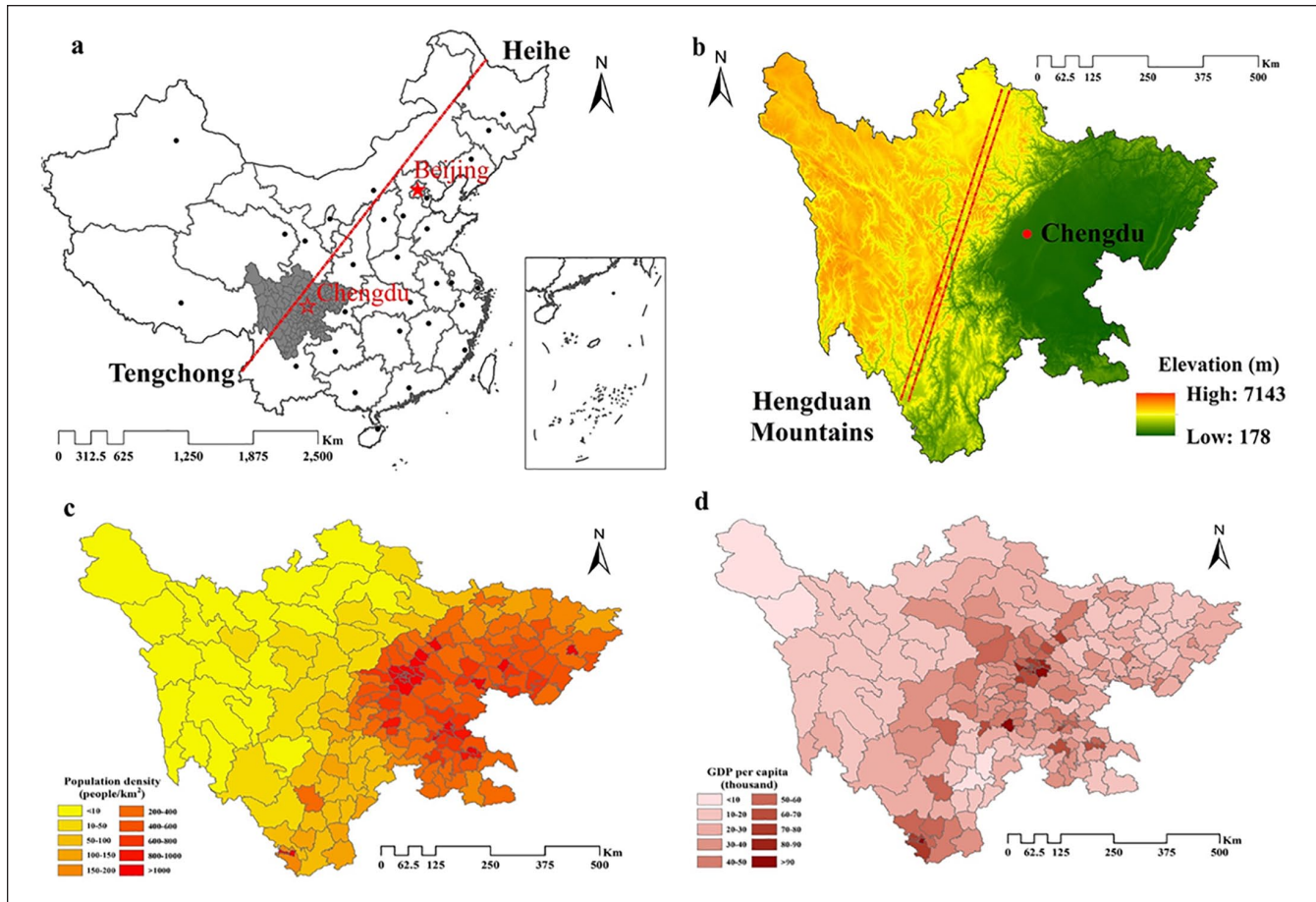


Figure 1. Geographic position, topography, demography, and economic development of Sichuan Province, China, 2015.

We employ a hospital as our unit of analysis. There are two components to our data: hospital-level data and county-level data. The hospital-level data are administrative data extracted from annual hospital reports provided by the Health Commission of Sichuan province, and they cover each hospital's basic and delivery information. A hospital's basic information includes hospital ownership (public, private non-profit, and private for-profit), hospital level (primary, secondary, tertiary, and un-graded), whether general, and the total number of hospital beds; the delivery information includes the number of medical disputes and patient volume in the last year. The county-level data are from the statistical yearbook of Sichuan province, and include each county's population, urbanization rate, and GDP per capita.

The data were included, imputed, and excluded as follows. First, all hospitals were included: a total of 7542 observations in Sichuan province during 2012 to 2015. Second, missing item values of patient volume, number of medical disputes, and number of hospital beds were imputed. The missing value of a certain hospital's patient volume was imputed using that hospital's mean value or the mean value of all hospitals across years. Missing medical dispute values were dealt with in the same way, except the median value

was used instead of the mean; missing values for the total number of hospital beds were imputed using previous data. Third, we excluded observations with zero patient volume, as no medical disputes could arise in this situation. Our final dataset consists of 7366 observations from 2012 to 2015. To validate the robustness of our results, we listed the results excluding all incomplete observations and observations with zero patient volume; see Figures S1 and S2 and Tables S1 and S2 in the Supplemental Appendix for details.

Variables

The outcome variable in this study is the number of medical disputes of one hospital in the last year. According to the Health Commission of Sichuan province, a medical dispute refers to a dispute between a patient (or the patient's relatives) and a hospital due to dissatisfaction with the medical services offered by the hospital; medical disputes are recorded by the patient's registration of a complaint. Our measure would capture most of the medical disputes. However, only a dispute registered at the hospital would be recorded. For example, minor disputes (resolved in a timely manner or in private) may not be included in our dataset.

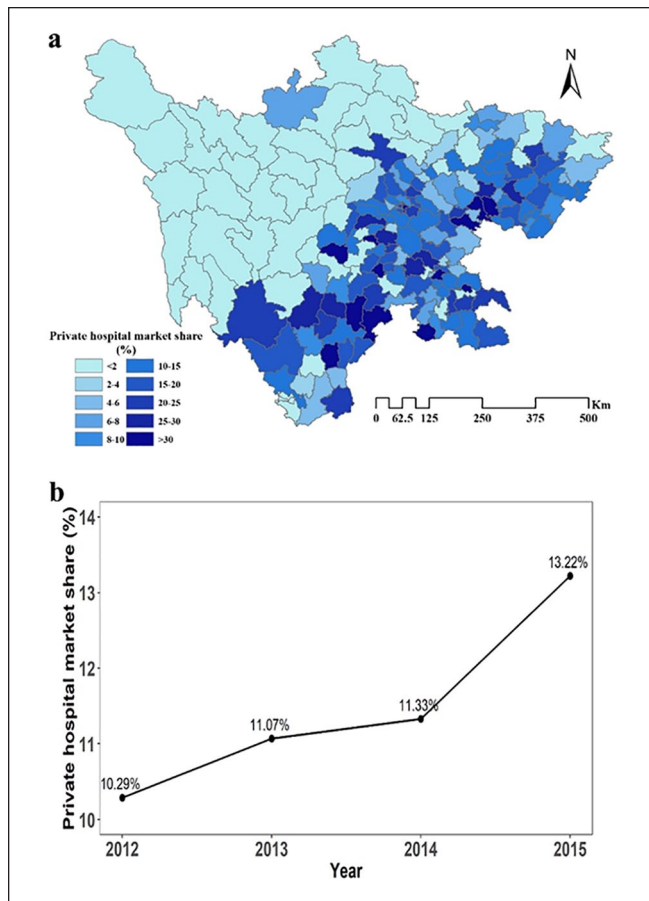


Figure 2. Variation in private hospital market share across time and regions.

Thus, we are unable to estimate the unrecorded disputes, which are not shown in our measure.

Figure 3 shows the distribution of medical disputes in our dataset. This histogram illustrates that the distribution of medical disputes exhibits considerable variation: an extremely large number of hospitals have no medical disputes, while some hospitals experience more than 10 disputes annually. The histogram hints at the zero-inflation and overdispersion of the distribution of medical disputes.

The key independent variable of interest is the market mix of hospital ownership measured by the private hospital market share. Following related studies, we use the administrative county to define a hospital market.^{32,42-45} This allows identification of potential competitors in a county, and the area of each hospital market corresponds to the government regulation jurisdiction. Within each county, we calculate the private hospital market’s share of total medical expenses.^{19,38} In the regression analysis, a set of covariables are controlled, including hospital characteristics, county characteristics, and year dummies.

Table 1 presents the detailed definitions and summary statistics of key variables. The average and standard deviation of the number of medical disputes are 3.180 and 9.535,

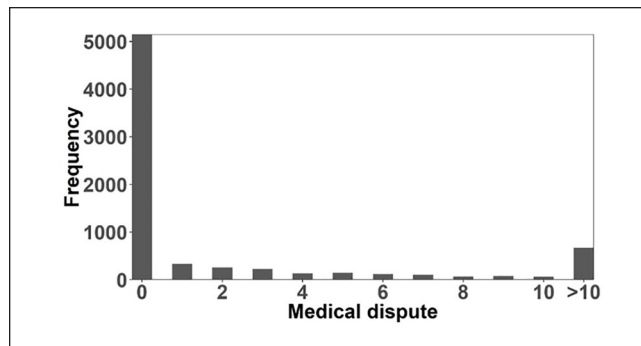


Figure 3. Frequency distribution of the number of medical disputes.

respectively, demonstrating a considerable overdispersion in the raw data. The private hospital market share ranges from 0 to 1, with average and standard deviations of 0.125 and 0.100, respectively. Compared with the relatively smaller market share, the total number of private hospitals exceeds the public ones. The proportions of public, private non-profit, and private for-profit hospitals are 44.8%, 17.1%, and 38.1%, respectively. The majority (53.2%) of the hospitals are ungraded, followed by secondary (25.3%), primary (15.2%), and tertiary (6.3%) hospitals. Among them, general hospitals account for 62.2% of the analyzed sample. There is an average of 168 hospital beds in our sample, while the average annual patient volume is 83 270 visits. As for regional economic development, the average GDP per capita during the period is 41 999 Yuan. The proportion (45.7%) of urban residents is lower than the rural, while each county has an average population of 671 530.

Methods

As medical disputes have not been studied widely, we have no literature similar to our research problem as a reference in the selection of estimation models. Medical disputes are measured as nonnegative, integer-valued count data, with excessive zero values and overdispersion observed in the sample. Several regression models can be applied to model count data, including Poisson, negative binomial, zero-inflated, and hurdle models.^{46,47} Although the negative binomial model relaxes the assumption required by the Poisson model that the conditional mean of a dependent variable equals its conditional variance (overdispersion, otherwise), neither of these can handle the zero-inflated problem. Considering the potential overdispersion and zero-inflated problems in our data, as well as the superiority of interpretability compared with the zero-inflated model,^{48,49} we referred to relevant research⁴⁸⁻⁵¹ with similar types of data and finally selected the hurdle model for our study.

The hurdle model, the analog of a two-part model, has the following two parts in our study⁵²: the hurdle part and the count part. The hurdle part models a right-censored

Table 1. Definitions and Summary Statistics of Key Variables.

Variables	Definition	Mean	SD	Proportion	Max	Min
Dependent variable						
Number of medical disputes	Number of disputes between patients (or their relatives) and hospitals	3.18	9.54	—	225	0
Main explanatory variables						
Private hospital market share	Hospital market privatization degree	0.13	0.10		1	0
<i>Hospital characteristics</i>						
Hospital ownership	0 = public, 1 = private non-profit, 2 = private for-profit					
Public		3298	—	44.77	—	—
Private non-profit		1263	—	17.15	—	—
Private for-profit		2805	—	38.08	—	—
Hospital level	0 = primary, 1 = secondary, 2 = tertiary, 9 = un-graded					
Primary		1119	—	15.19	—	—
Secondary		1866	—	25.33	—	—
Tertiary		464	—	6.30	—	—
Un-graded		3917	—	53.18	—	—
Whether general	0 = no, 1 = yes	4585	—	62.25	—	—
Total number of hospital beds	Number of beds within a hospital	167.97	290.16	—	4686	0
Patient volume (10 000)	Patient volume for a hospital	8.33	21.77	—	4712391	1
<i>County characteristics</i>						
GDP per capita (Yuan)	Gross domestic product per capita for a county	41 998.50	22 805.52	—	121 500	6904.53
Urbanization rate (%)	Proportion of total urban population for a county	45.72	27.77	—	100	4.59
Population (10 000)	Total population for a county	67.15	33.82	—	172.51	2.60
<i>Dummy variable</i>						
Year	Dummy variables					
Observations	Sample size (7366)					

Note. (1) All the categorical variables use the “0” as reference group in the regression analysis. (2) Unless otherwise indicated, data are expressed as weighted numbers (percentages) within the variables. Estimated counts were rounded to the nearest unit, and thus totals across categories may differ from the calculated sums.

dependent variable indicating hospitals with $Disputes = 0$ or $Disputes > 0$, where all values larger than 0 are fixed at 1. In the count part, once the hurdle is crossed (for observations with $Disputes > 0$), the truncated Poisson or negative binomial model is applied to model the left-truncated dependent variable, $Disputes$, which now has a strictly positive count. The extensive margins (zero vs nonzero) and intensive margins (how much if nonzero) are estimated separately as follows:

$$P(Y_i = Disputes_i | x_i, s_i, z_i, \beta, \gamma) = \begin{cases} \frac{f_{zero}(Disputes_i = 0; s_i, z_i; \gamma)}{(1 - f_{zero}(Disputes_i = 0; s_i, z_i; \gamma))} & \text{if } Disputes_i = 0 \\ \frac{f_{count}(Disputes_i; s_i, x_i; \beta)}{(1 - f_{count}(Disputes_i = 0; s_i, x_i; \beta))} & \text{if } Disputes_i > 0 \end{cases}$$

where $Disputes_i$ is the number of medical disputes for hospital i . s_i is the private hospital market share. z_i and x_i represent

a vector of covariates for the hurdle and count parts, respectively. In this study, both parts were set to share the same covariates, including hospital characteristics, county characteristics, and year dummies. γ and β are the vectors of coefficients belonging to z and x , respectively. f_{zero} is the probability density function of the hurdle part, typically modeled with a binary logit model (logistic regression). f_{count} is the counterpart of the count part, typically modeled with a left-truncated ($Disputes_i > 0$) Poisson model or negative binomial model.

In this study, the logit model is selected to specify the hurdle part (f_{zero}), and the left-truncated negative binomial model is chosen to specify the count part (f_{count}). Specification tests between the Poisson, negative binomial, Poisson hurdle, and negative binomial hurdle models were conducted to select the most appropriate model. The Vuong test⁵³ was applied to the examination between the non-nested models (i.e., the Poisson and Poisson hurdle models), where a positive significant statistic was set to support hurdle model. The

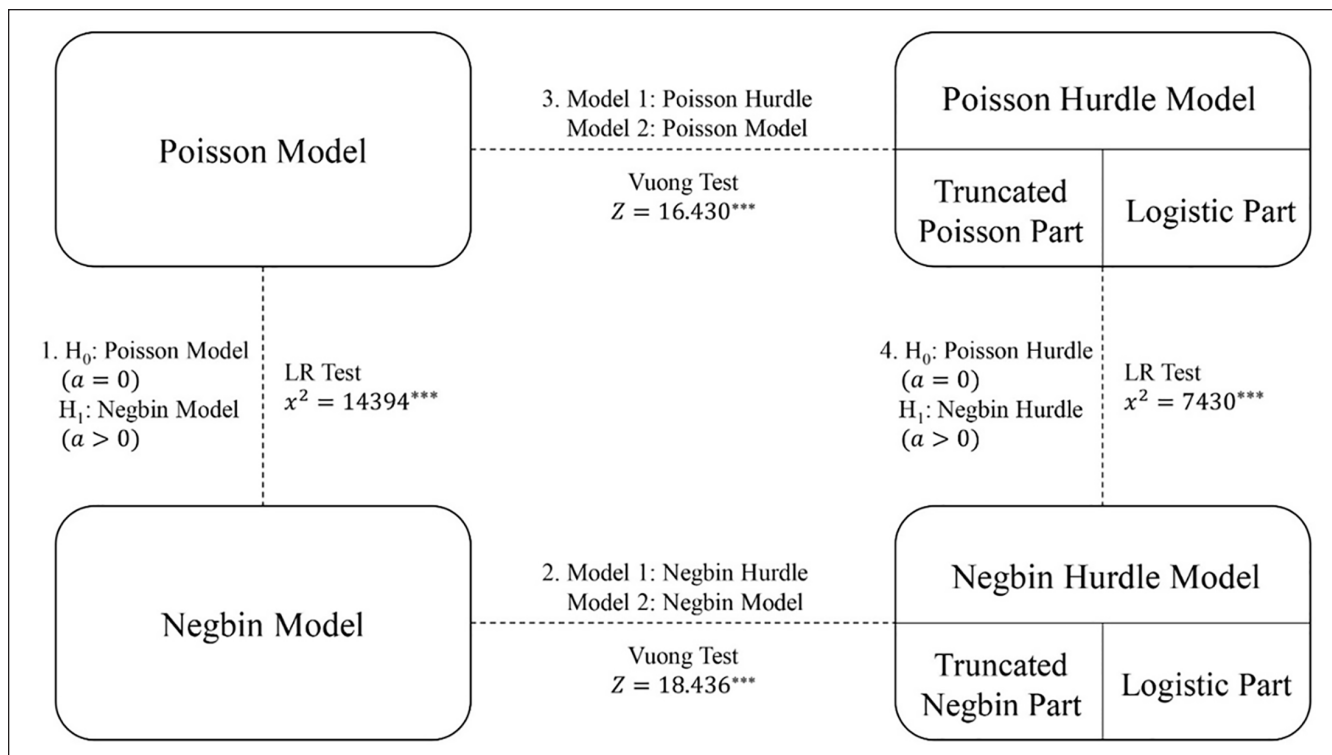


Figure 4. Specification tests.

Note. (1) The Negbin model represents a negative binomial model. (2) $***P < .001$. (3) LR test = likelihood ratio test.

likelihood ratio (LR) test was applied to compare the nested models (i.e., the Poisson and negative binomial models). Figure 4 shows the specification tests' results.

Therefore, the hurdle part targets the probability of the occurrence of medical disputes in a hospital, while the count part models the mean number of medical disputes for hospitals with medical disputes.

Clustered standard errors⁵⁴ (at the county level) are reported in this study. All analyses are conducted using R 3.5.1.

Results

Association of Market Mix of Hospital Ownership With Medical Disputes

The Lowess curves are first used to examine the relationship between medical disputes and the private hospital market share.⁵⁵ Although the curves are unadjusted for control variables, Figure 5 illustrates important features of the relationship.^a Figure 5a illustrates the Lowess curve of the mean probability of medical dispute occurrence against private hospital market share (for all observations), which hints at an approximately linear relationship between the two. Figure 5b shows the Lowess curve of the mean number of medical disputes against private hospital market share (for those observations with dispute occurrence), illustrating a nonlinear (more precisely, quadratic) relationship.

The Lowess curves imply that the independent variable of private hospital market share should be added to the hurdle part (logistic regression) in a linear form, while it should be added to the count part (negative binomial regression for those observations with dispute occurrence) in a quadratic form.

Table 2 reports the estimations using the negative binomial hurdle model. In the count part (negative binomial regression for those observations with medical disputes), the coefficients of both the private hospital market share and its quadratic term are statistically significant at the 5% level. The positive coefficient of the linear term and the negative coefficient of the quadratic term indicate that for hospitals with medical disputes there is an inverted U-shaped relationship between private hospital market share and the number of medical disputes. Moving to the parabolic curve, the inflection point lies at 0.231 $[-1.56/(-3.373*2)]$, which represents the worst case for medical disputes. The results suggest that for hospitals with medical disputes, as the private hospital market share increases, the number of medical disputes initially rises, but begins to decline after reaching the peak value at a private hospital market share of 0.231. However, in the hurdle part (logistic regression), we found no significant relationship between the private hospital market share and the probability of medical dispute occurrence.

In terms of the other covariables, for the count part—that is, parameter estimates conditional on a hospital with at least one dispute—the mean number of medical disputes for a

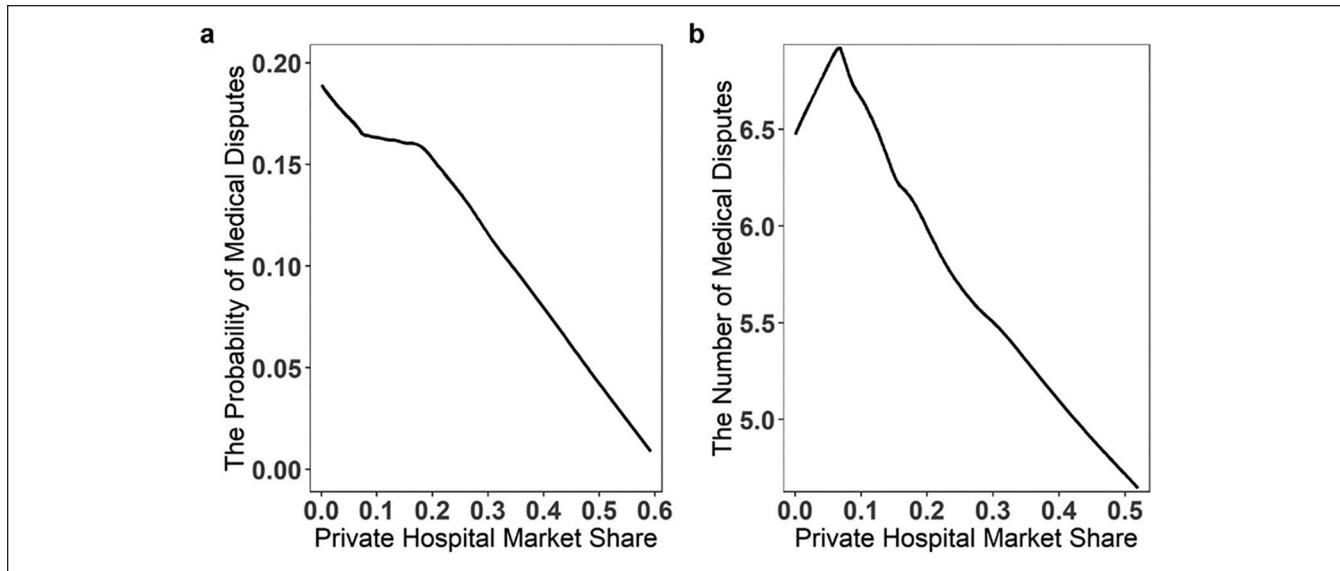


Figure 5. Lowess curve of medical disputes against private hospital market share.

Table 2. Negative Binomial Hurdle Model Results.

Variables	Hurdle model	
	Negative binomial regression	Logistic regression
Private hospital market share	1.56** [0.15, 2.97]	-0.12 [-1.42, 1.17]
Private hospital market share square	-3.37** [-6.43, -0.32]	—
Hospital ownership		
Public (reference)		
Private non-profit	-0.05 [-0.31, 0.21]	-0.01 [-0.40, 0.39]
Private for-profit	0.30 [-0.10, 0.71]	0.13 [-0.21, 0.48]
Hospital level		
Primary (reference)		
Secondary	0.59*** [0.28, 0.90]	0.89*** [0.55, 1.23]
Tertiary	0.59*** [0.23, 0.96]	0.73** [0.05, 1.40]
Un-graded	0.27 [-0.10, 0.64]	-0.10 [-0.42, 0.21]
Whether general		
No (reference)		
Yes	0.22*** [0.08, 0.35]	-0.01 [-0.23, 0.21]
Total number of hospital beds	0.00*** [0.00, 0.00]	0.00*** [0.00, 0.00]
Patient volume (log)	0.42*** [0.31, 0.52]	0.81*** [0.67, 0.95]
GDP per capita (log)	0.11 [-0.08, 0.30]	0.34** [0.03, 0.65]
Urbanization rate (%)	0.00 [-0.00, 0.01]	0.00 [-0.01, 0.01]
Population (10000)	0.00 [-0.00, 0.00]	0.00 [-0.00, 0.00]
Year dummies	Yes	Yes
N	7366	7366

Note. (1) GDP is adjusted for inflation rates, and measured in 2015 RMB. (2) The 95% confidence intervals calculated by clustered standard errors (at the county level) are shown in brackets.

** $p < .05$. *** $p < .001$.

secondary and tertiary hospital are 1.808 [$\exp(0.592)$] and 1.806 [$\exp(0.591)$] times that of a primary hospital, respectively. General hospitals tend to experience more disputes than specialized hospitals ($RR = 1.240$). More hospital beds

and greater patient volume are significantly associated with more medical disputes. Lastly, there are no significant differences associated with hospital ownership or county characteristics.

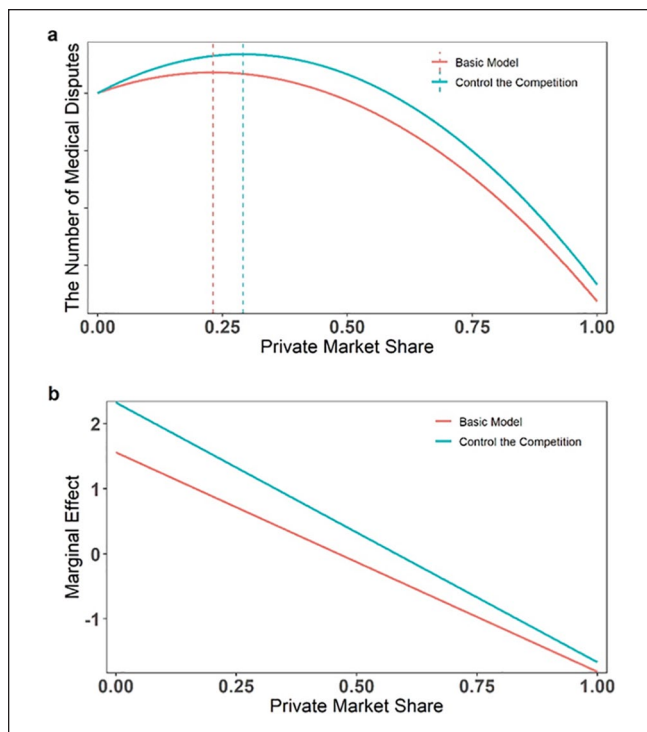


Figure 6. Discrepancy in the private hospital market share coefficients between the basic model and the model controlling for competition.

For the hurdle part, the expected odds ratio (*OR*) of a secondary and a tertiary hospital with dispute occurrence are 2.430 [$\exp(0.888)$] and 2.065 [$\exp(0.725)$] times that of a primary hospital, respectively. More hospital beds, greater patient volume, and higher GDP per capita are significantly associated with a higher likelihood of medical dispute occurrence. There are no significant differences associated with other hospital features or county characteristics.

Competition Mechanism Analysis

As mentioned in the introduction, two possible mechanisms are proposed to summarize how the growth in the private hospital market share affects medical disputes: competition and regulation. In this section, we aim to verify how the competition mechanism works.

Figure 6 illustrates the discrepancy in the private hospital market share coefficients (linear and quadratic terms) for the count part of the hurdle model between the basic model and a model that further controls for the Herfindahl-Hirschman index (HHI), which is commonly used to measure the degree of hospital competition.^b The red and blue curves in Figure 6a show, conditioned on the other covariables, the effect of the private hospital market share on the number of medical disputes in the basic model and in the model that further controls for the degree of competition, respectively. Figure 6b shows the variation in the first-order derivative

(marginal effect) of both the linear and quadratic private hospital market share terms according to changes in the private hospital market share. We also added the interaction of the market mix and HHI into the hurdle model to explore whether there is any modification effect. However, the interaction is statistically insignificant. We do not report the results here due to space limitation.

The likelihood ratio test between the basic model and the model controlling competition shows that there is statistical significance between the two models, as shown in Table 3. The results show that after controlling for competition (so that the increase in private hospital market share does not lead to increased hospital competition), in the inverted U-shaped relationship between the private hospital market share and number of medical disputes, the rising part of the concave curve rises faster, while the falling part falls more slowly. This implies that competition plays a protective role in the effect of private hospital market share on the number of medical disputes: competition could hinder the number increase and facilitate a more rapid drop. Besides, adding the competition variable to the basic model would shift the inflection point of the concave curve to the right, which means the number of disputes would begin to decline with a higher private hospital market share.

The following analyses are conducted to further explore whether hospitals would compete with each other by improving medical quality when there is growth in the private hospital market share. Figure 7a and b illustrates the discrepancy in the private hospital market share coefficients for the count part of the hurdle model between the basic model and the model that further controls for medical quality.^c The two parts in Figure 7 are similar to those in Figure 6. The results show that there are slight differences in the concave curve and marginal effect between the basic model and the model controlling for medical quality, which implies that medical quality plays an insignificant role in the effect of the private hospital market share on the number of medical disputes. The likelihood ratio test shows that there is statistical insignificance between the two models, as shown in Table 3.

Robustness Tests

In our main regression analysis, the private hospital market share of patient expenses is selected to measure the market mix of hospital ownership. To test the robustness of this measurement, we alternatively calculate the private hospital market share based on the total number of hospital beds and patient volume. Furthermore, to test the sensitivity to a different approach to defining the hospital market, we alternatively use the fixed radius approach of 15 miles⁵⁶ to redefine the hospital market. As a further robustness check, to determine whether the outliers would significantly affect our overall results, we excluded outliers with more than 50 disputes.

Table 4 reports the results of the robustness tests. The results are similar to our main regression results in terms of

Table 3. Likelihood Ratio Tests Results.

	Df	Log-likelihood	Chi-squared
Basic model versus model controlling competition	3	-17.7	35.33***
Basic model versus model controlling medical quality	2	-1.8	3.65

Note. (1) Df= degrees of freedom. (2) Log-likelihood means the log-likelihood of the basic model minus that of the model controlling competition or medical quality.
 *** $P < .001$.

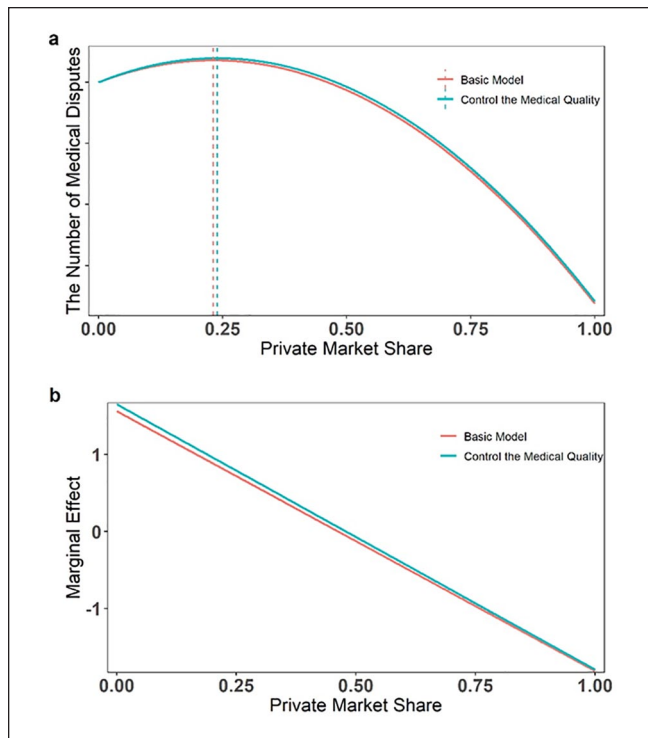


Figure 7. Discrepancy in the private hospital market share coefficients between the basic model and the model controlling for medical quality.

signs, inflection points, and statistical significance of the coefficient estimates, indicating the robustness of our results.

Discussion

In this study, we employ a negative binomial hurdle model to explore the relationship between the market mix of hospital ownership and medical disputes. The empirical results show that for hospitals with medical disputes, the private hospital market share has an inverted U-shaped relationship with the number of medical disputes. The number of medical disputes reaches the peak value at a private hospital market share of 0.231.

For hospitals with disputes, there is a positive correlation between the private hospital market share and the number of medical disputes at a relatively low level of private hospital market share. These results may be related to the survival dilemma of private hospitals at that stage. When the private

sector in the hospital market is weak, such as in the early stage of the new round of national health reforms in China, private hospitals are generally characterized by small scale, weak physician and medical equipment resources, and a majority of specialty hospitals.^{57,58} Therefore, compared with public hospitals, private hospitals have more difficulty attracting patients, making their survival more difficult. Given the pressure of survival, they may conduct undesirable activities that generate immediate benefits to keep the hospitals operating. These undesirable activities consist of three primary types: decreasing hospital costs, attracting more patients, and increasing patients’ medical expenses. Specifically, they may simplify medical services to decrease hospital costs, exploit misleading propaganda to attract more patients, and induce patients’ demand for healthcare, which are the major causes of medical disputes.^{1,7,59} Due to loose government regulations at this stage, private hospitals could engage in these activities effortlessly.

Although competition plays a protective role in the effect of the private hospital market share on the number of medical disputes, the competition mechanism does not dominate at this stage. The undesirable actions described above are attributed to the weakness and loose regulation of private hospitals. While growth in the private hospital market share fuels competition, more unregulated weak private hospitals are introduced to the market, which could result in the prevalence of undesirable actions. This would exacerbate the market environment and induce hospitals with disputes to engage in more of these actions, ultimately increasing the number of medical disputes.

When the private hospital market share reaches a certain level, the government will begin to pay attention to the private hospital market sector and will gradually strengthen supervision and regulation, rectifying the undesirable actions mentioned above. At this point, the vicious circle would be broken and the role of competition may begin to dominate in hospital markets, resulting in hospitals providing more satisfactory medical services as the private hospital market grows. Meanwhile, to attract more patients in the future, hospitals, especially private hospitals, must emphasize building their market reputation and obtain feedback from patients. Therefore, the private hospital market share is negatively correlated with the number of medical disputes at this stage.

The results of analyzing the competition mechanism show that the effect of the market mix of hospital ownership on the number of medical disputes is partly explained by hospital

Table 4. Robustness Test Results.

Variables	Hurdle model	
	Negative binomial regression	Logistic regression
Private hospital market share (calculated by total number of hospital beds)	1.48** [0.21, 2.75]	0.17 [-0.66, 0.99]
Private market share square (calculated by total number of hospital beds)	-2.17* [-4.47, 0.14]	—
Other control variables	Yes	
N	7366	
Private hospital market share (calculated by patient volume)	1.34* [-0.05, 2.72]	-0.55 [-1.71, 0.61]
Private market share square (calculated by patient volume)	-2.21** [-4.40, -0.03]	—
Other control variables	Yes	
N	7366	
Private hospital market share (hospital market defined by the fixed radius approach, 15miles)	0.97 [-0.20, 2.14]	0.31 [-0.39, 0.10]
Private market share square (hospital market defined by the fixed radius approach, 15 miles)	-1.76** [-3.35, -0.18]	—
Other control variables	Yes	
N	7366	
Private market share (outliers with more than 50 disputes excluded)	0.98* [-0.17, 2.13]	-1.25 [-1.42, 1.17]
Private market share square (outliers with more than 50 disputes excluded)	-2.35** [-4.49, -0.21]	—
Other control variables	Yes	
N	7313	

Note. (1) GDP is adjusted for inflation rates and measured in 2015 RMB. (2) Other control variables include the following: hospital ownership and level, whether general, total number of hospital beds, patient volume, GDP per capita, urbanization rate, population and year dummies. (3) The 95% confidence intervals calculated by clustered standard errors (at the county level) are shown in brackets.

* $P < .1$. ** $P < .05$.

competition. The statistical significance^d of both the linear and quadratic terms of private hospital market share in the count part of the analysis after controlling for competition implies that the effect of the market mix of hospital ownership on the number of medical disputes is not achieved only through the competition mechanism. The remaining effect after controlling for hospital competition is likely to be achieved through reform of the entire healthcare delivery system, which is induced by the introduction of market mix of hospital ownership.⁶⁰ Interestingly, we also find that competition plays a protective role in the effect of the market mix of hospital ownership on the number of medical disputes. It alleviates the negative effect of introducing private hospitals and strengthens the positive effect, which means that the market mix of hospital ownership can improve the health services delivery system's performance through hospital competition. Therefore, we suggest that while authorities are encouraging more private hospitals to enter the hospital market, a better policy environment should be designed to facilitate well-ordered competition. Further, the results also support encouraging new private hospitals rather than privatizing existing public hospitals in China. Compared with privatizing public hospitals, encouraging new private hospitals would intensify both the competition and private hospital market share. Thus the change in disputes, which shows its better attribute, would result from the two components.

Moreover, the results of the analysis of medical quality show that quality plays an insignificant role in the effect of the private hospital market share on the number of medical

disputes. This implies that, currently, private hospitals seldom compete with other hospitals through medical quality. According to the 2018 Health Statistical Yearbook of China, nearly 90% of tertiary hospitals are state-owned; private hospitals are primarily low-level hospitals.¹⁸ The condition of patients in private hospitals is generally modest, and they are not particularly sensitive to medical quality. Thus, private hospitals lack motivation to improve medical quality. What is more, better quality usually leads to higher costs, which are not conducive to the ability of private hospitals to attract lower- and middle-income patients.⁶¹ Our findings are somewhat different from those of previous researchers, such as Liu et al¹ who find that medical quality is correlated with dental disputes. There are two possible reasons for the difference. First, as we discussed above, the medical quality of hospitals may be not an intermediate variable in the causal path of the influence of private hospital market share on medical disputes. Second, inpatient mortality was employed as a proxy of medical quality in our study, and it might not comprehensively reflect all dimensions of quality. In contrast, Liu et al¹ captured medical quality more comprehensively, including communication, patients' expectations, complications, and treatment failure. When facing competition, hospitals may improve quality dimensions that are easily observed and understood by patients,^{62,63} which could lead to the difference in the findings of the two studies.

Another difference in findings between our study and those of previous researchers is that Tucker et al⁶ found that the pursuit of profits systematically erodes patient-physician

trust, leading to a difference in the number of medical disputes between different hospital ownerships, while the differences between the coefficients of different hospital ownerships are insignificant in our study. Tucker et al⁶ conducted qualitative research and mainly focused on patient-physician trust. However, there are many factors affecting the difference in the number of medical disputes between public and private hospitals, such as waiting time, hospital environment, and physicians' attitudes, which could lead to the difference between our findings and theirs.

We recognize that this study has several limitations. First, the analysis strategy used in this study cannot completely solve the endogeneity problem. There are potential omitted variables, such as social mood and local governance, which would affect both the independent and dependent variables. Second, self-selection bias does exist in our study, and we cannot correct it due to lack of individual information. However, for our key independent variable of private hospital market share, we believe that self-selection bias would not have a sizable influence on the coefficient estimation. The private hospital market share is a market-level rather than facility-level attribute. Given the disease spectrum, hospital characteristics, and hospital market characteristics, it is reasonable for us to assume that patients who constitute the private hospital market share in various hospital markets have insignificant differences in their conditions. For example, the private hospital market share in both markets A and B is 30%—if, private hospitals in market A mainly have patients with severe diseases, it is unlikely that private hospitals in market B would have patients with opposite cases. Thus, we believe that the self-selection bias would not have a significant impact on our main conclusions. Third, we suggest encouraging new private hospitals in China rather than privatizing existing public hospitals. For this policy proposal, we did not validate the rationale directly, for example, through direct comparison of the difference in the impacts of new private hospitals in the hospital market and privatization of public hospitals on medical disputes. This is mainly because privatization of public hospitals is very rare in our dataset. This defect impairs the strength of the evidence for our policy proposal.

Conclusion

To enhance healthcare services' supply and fuel hospital competition, a series of policies have been implemented in China since 2009 to encourage private hospitals. Our study demonstrates that, for hospitals with medical disputes, the private hospital market share has an inverted U-shaped association with the number of medical disputes. Further analysis shows that competition plays a protective role in the effect of the private hospital market share on the number of medical disputes: competition could hinder the number increase and facilitate a more rapid drop. The findings support

encouraging new private hospitals rather than privatizing existing public hospitals in China, providing important policy implications for ongoing discussions on the reform of the market mix of hospital ownership.

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ORCID iDs

Tianjiao Lan  <https://orcid.org/0000-0003-4373-3477>

Jay Pan  <https://orcid.org/0000-0001-9501-1535>

Supplemental Material

Supplemental material for this article is available online.

Notes

- We drop the observations with private hospital market share equaling 1 ($n=8$), since there is no observation between 0.6 and 1 for this variable and including them would cause an outlier in Lowess scatter plot.
- Herfindahl-Hirschman Index (HHI) is selected to measure the hospital competition.^{64,65} The calculation formula is:

$$HHI_{hm} = \sum_{h=1}^n \left(\frac{R_{hm}}{R_m} \right)^2$$
 Where R_{hm} refers to the hospital h 's patient expenses in market m , while R_m the sum of patient expenses of all hospitals in market m . Geopolitical boundaries approach is used to define the hospital market. Following theory and findings of Yang et al,²⁰ we add both linear and quadratic terms of HHI to hurdle part and count part in basic model.
- Inpatient mortality⁶⁶ is selected to measure the hospital medical quality, defined as the proportion of death toll among inpatient discharges annually. After imputing the missing items by the way same as the patient volume, the linear term of inpatient mortality is added to hurdle part and count part in basic model.

- d. The coefficients for linear and quadratic terms of private hospital market share are significant at 5% level with P -values calculated by clustered standard error. Due to the space limitation, the regression analysis results that control the competition are not reported in the paper, but available upon request.

Reference

- Liu Z, Zhang Y, Asante JO, Huang Y, Wang X, Chen L. Characteristics of medical disputes arising from dental practice in Guangzhou, China: an observational study. *BMJ Open*. 2018;8(2):e018738. doi:10.1136/bmjopen-2017-018738
- How to resolve 70,000 medical disputes a year? *China Youth Online*. 2014. Accessed August 20, 2019. http://zqb.cyol.com/html/2014-04/08/nw.D110000zgqnb_20140408_1-05.htm
- Regulations on the Prevention and Handling of Medical Disputes came into effect on 1 October. *Beijing Youth Daily*. Published September 10, 2018. Accessed August 20, 2019. http://hn.cnr.cn/hngbjk/20180910/t20180910_524356139.shtml
- Zhang X, Sleeboom-Faulkner M. Tensions between medical professionals and patients in mainland China. *Camb Q Healthc Ethics*. 2011;20(03):458-465. doi:10.1017/S0963180111000144
- The Lancet. Ending violence against doctors in China. *Lancet*. 2012;379(9828):1764. doi:10.1016/S0140-6736(12)60729-6
- Tucker JD, Cheng Y, Wong B, et al. Patient-physician mistrust and violence against physicians in Guangdong Province, China: a qualitative study. *BMJ Open*. 2015;5(10):e008221. doi:10.1136/bmjopen-2015-008221
- Hesketh T, Wu D, Mao L, Ma N. Violence against doctors in China. *BMJ*. 2012;345(1):e5730-e5730. doi:10.1136/bmj.e5730
- Zhong G. Yi Nao incidents increased by 7000 over last five years: illegal gangs made huge profits. Published 2012. Accessed June 2, 2019. http://www.china.com.cn/news/2012-05/03/content_25287333_2.htm
- Xinhua Daily Telegraph. Who makes doctors sit on top of volcanoes? Published October 31, 2013. Accessed August 8, 2019. http://news.xinhuanet.com/mrdx/2013-10/31/c_132847265.htm
- Lyu S-Y, Liao C-K, Chang K-P, Tsai S-T, Lee M-B, Tsai F-C. Analysis of medical litigation among patients with medical disputes in cosmetic surgery in Taiwan. *Aesthetic Plast Surg*. 2011;35(5):764-772. doi:10.1007/s00266-011-9684-1
- State Council, People's Republic of China. The standing conference of State Council of China adopted guidelines for furthering the reform of health-care system in principle. Published 2009. Accessed August 1, 2019. http://www.gov.cn/jrzg/2009-04/06/content_1278721.htm
- Pan J, Lei X, Liu GG. Health insurance and health status: exploring the causal effect from a policy intervention: health insurance and health status: exploring the causal effect. *Health Econ*. 2016;25(11):1389-1402. doi:10.1002/hec.3225
- State Council, People's Republic of China. Notice on further encouraging and guiding the establishment of medical institutions by social capital. Published 2010. Accessed August 2, 2019. http://www.gov.cn/xxgk/pub/govpublic/mrlm/201012/t20101203_63073.html
- Barber SL, Kumar A, Roubal T, Colombo F, Lorenzoni L. Harnessing the private health sector by using prices as a policy instrument: lessons learned from South Africa. *Health Policy*. 2018;122(5):558-564. doi:10.1016/j.healthpol.2018.03.018
- Engström AK, Axelsson R. The double spiral of change-experiences of privatization in a Swedish hospital. *Int J Health Plann Manage*. 2010;25(2):156-168. doi:10.1002/hpm.968
- Maarse H. The privatization of health care in Europe: an eight-country Analysis. *J Health Polit Policy Law*. 2006;31(5):981-1014. doi:10.1215/03616878-2006-014
- Health and Family Planning Commission of China(2009). Health statistical yearbook of China (2010). *Beijing Peking Union Med Coll Press*. Accessed August 1, 2019. <http://data.cnki.net/Yearbook/Single/N2010090866>
- Health and Family Planning Commission of China (2017). Health statistical yearbook of China (2018). *Beijing Peking Union Med Coll Press*. Published online 2018. Accessed August 1, 2019. <http://data.cnki.net/Yearbook/Single/N2019030282>
- Pan J, Liu D, Ali S. Patient dissatisfaction in China: what matters. *Soc Sci Med*. 2015;143:145-153. doi:10.1016/j.socscimed.2015.08.051
- Yang Q, Pan J. Control under times of uncertainty: the relationship between hospital competition and physician-patient disputes. *Int J Equity Health*. 2017;16(1):205. doi:10.1186/s12939-017-0701-0
- Yu H, Hu Z, Zhang X, Li B, Zhou S. How to overcome violence against Healthcare professionals, reduce medical disputes and ensure patient safety. *Pak J Med Sci*. 2015;31(1):4-8. doi:10.12669/pjms.311.6446
- Deng C, Li X, Pan J. Private hospital expansion in China: a global perspective. *Glob Health J*. 2018;2(2):33-46. doi:10.1016/S2414-6447(19)30138-1
- Kruse FM, Jeurissen PPT. For-profit hospitals out of business? Financial sustainability during the COVID-19 epidemic emergency response. *Int J Health Policy Manag*. Published online May 4, 2020. doi:10.34172/ijhpm.2020.67
- Hou X, Coyne J. The emergence of proprietary medical facilities in China. *Health Policy*. 2008;88(1):141-151. doi:10.1016/j.healthpol.2008.03.004
- Health Commission of China. Administrative measures on different levels of hospitals (trial draft). Published 1989. Accessed August 3, 2020. <https://zh.wikisource.org/wiki/%E5%8C%BB%E9%99%A2%E5%88%86%E7%BA%A7%E7%AE%A1%E7%90%86%E5%8A%9E%E6%B3%95%EF%BC%88%E8%AF%95%E8%A1%8C%E8%8D%89%E6%A1%88%EF%BC%89>
- Wang X, Yang H, Duan Z, Pan J. Spatial accessibility of primary health care in China: a case study in Sichuan Province. *Soc Sci Med*. 2018;209:14-24. doi:10.1016/j.socscimed.2018.05.023
- Xu J, Liu G, Deng G, Li L, Xiong X, Basu K. A comparison of outpatient healthcare expenditures between public and private medical institutions in urban China: an instrumental variable approach: comparison of outpatient healthcare expenditure in urban china. *Health Econ*. 2015;24(3):270-279. doi:10.1002/hec.3015
- Preker AS, Harding A, Travis P. "Make or buy" decisions in the production of health care goods and services: new insights

61. Liu Y, Berman P, Yip W, et al. Health care in China: the role of non-government providers. *Health Policy*. 2006;77(2): 212-220. doi:10.1016/j.healthpol.2005.07.002
62. Propper C, Burgess S, Gossage D. Competition and quality: evidence from the NHS Internal Market 1991-'9. *Econ J*. 2008;118(525):138-170. doi:10.1111/j.1468-0297.2007.02107.x
63. Mutter RL, Wong HS, Goldfarb MG. The effects of hospital competition on inpatient quality of care. *Inq J Health Care Organ Provis Financ*. 2008;45(3):263-279. doi:10.5034/inquiryjml_45.03.263
64. Pan J, Qin X, Li Q, Messina JP, Delamater PL. Does hospital competition improve health care delivery in China? *China Econ Rev*. 2015;33:179-199. doi:10.1016/j.chieco.2015.02.002
65. Lu L, Pan J. The association of hospital competition with inpatient costs of stroke: evidence from China. *Soc Sci Med*. 2019;230:234-245. doi:10.1016/j.socscimed.2019.04.017
66. Dubois RW, Rogers WH, Moxley JH, Draper D, Brook RH. Hospital inpatient mortality. *N Engl J Med*. 1987;317(26): 1674-1680. doi:10.1056/NEJM198712243172626